## REMARKS

This Amendment is submitted in response to the Office Action dated February 28, 2005. In view of the foregoing amendments, and the comments that follow, favorable reconsideration is respectfully requested.

Claims 1-55 are now pending in the application. In the Office Action, the Examiner rejected claims 1-4, 6, 20-28, and 39 under 35 U.S.C. § 103(a) as unpatentable over Perry et al (USP 6,621,040) in view of Harter et al (USP 5,696,782). The Examiner also rejected claims 10 and 11 under § 103(a) as unpatentable over Harter in view of Zweiback et al (USP 6,833,954). In addition, the Examiner rejected claims 15-19 under § 103(a) as unpatentable over Stock et al (USP 6,249,630) in view of Harter. The Examiner also rejected claims 49 and 50 under § 103(a) as unpatentable over Harter.

In addition, the Examiner rejected claims 29 and 30 under 35 U.S.C. § 102(b) as anticipated by Galvanauskas et al (USP 6,198,568). The Examiner also rejected claim 40 under § 102(b) as anticipated by Harter. Finally, the Examiner rejected claim 48 under § 102(b) as anticipated by Galvanauskas et al (USP 5,847,865).

Although the Examiner listed claim 44 as rejected in the Office Action Summary, the Examiner did not include claim 44 in any actual rejection. Therefore, the Applicants assume that claim 44 is allowable as originally submitted.

The Applicants appreciate the Examiner's acknowledgement of allowable subject matter in claims 5, 7-9, 31-38, 41, and 45-47.

**Rejection of Claims 1-4, 6, 20-28, and 39 under § 103(a) as unpatentable over Perry in view of Harter**

The Examiner asserts that Perry discloses a chirped pulse amplification system comprising a pulse stretcher (12) that produces stretched pulses having a duration longer than 100 ps, 300 ps, or 1 ns; at least one amplifier (14) following the pulse stretcher; and a pulse compressor (16) compressing the pulses by a factor greater than 50 or 150. However, the Examiner notes that Perry does not use a fiber Bragg grating as the pulse stretcher (12), and asserts that Harter shows that fiber Bragg gratings were known at the time of the present application to have been used for pulse stretching in the same type of structure disclosed by Perry. The Applicants respectfully traverse this rejection.

Neither Perry nor Harter teach or suggest the use of a *nonlinearly* chirped fiber Bragg grating pulse stretcher system for producing stretched pulses in a chirped pulse amplification system. As the Examiner notes, Perry does not use a fiber Bragg grating as the pulse stretcher (12). Also, the pulse stretcher system (12) in Perry uses only a *linearly* chirped bulk grating (col. 5, lines 55-60). Similarly, Harter uses only a *linearly* chirped fiber Bragg grating (720) to stretch the pulses (col. 10, lines 16-20). Therefore, because the present claims recite only a *nonlinearly* chirped fiber Bragg grating pulse stretcher system, the Applicants believe that claims 1-4, 6, 24-28, and 39 are patentable over Perry, Harter, and their combination.

In addition, contrary to the Examiner's assertion, Perry does not teach or suggest the use of a fiber Bragg grating as a pulse stretcher in a chirped pulse amplification system with a pulse compression ratio greater than 50 or 150. Although Perry discusses a compression ratio of 5000 (col. 5, lines 59-60), this is only obtained with a precisely matched bulk grating stretcher and

compressor, not a fiber Bragg grating pulse stretcher. It is well known in the art that without the use of precise dispersion matching between a bulk grating stretcher and a bulk grating compressor, the compression ratio in chirped pulse amplification systems is generally limited to about 50. Therefore, Perry does not anticipate the use of a compression ratio greater than 50 with anything but a precisely matched bulk grating stretcher and bulk grating compressor. In fact, Perry teaches away from the use of anything other than bulk grating stretchers and compressors (col. 5, lines 48-52). Therefore, the Applicants believe that claims 1-3 are allowable as amended.

The Examiner asserts that the amplifier (14) of Perry directly teaches claim 4. However, Perry discloses only solid state amplifiers, in which the pulse makes multiple passes through a gain medium (col. 5, line 65 - col. 6, line 8). In contrast, amended claim 4 states that the fiber amplifier in the current invention is a diode laser amplifier, a parametric amplifier, a Raman amplifier, or a combination thereof. Because these amplifiers are distinct from Perry's solid state amplifier, the Applicants believe that claim 4 is allowable as amended.

The Examiner asserts that Perry teaches claim 6. However, compressor (16) comprises only a bulk grating compressor, not a combination of at least one fiber Bragg grating compressor and a bulk grating compressor, as in claim 6. As discussed above, Perry uses a precisely matched bulk grating stretcher and bulk grating compressor, and does not anticipate that dispersion matching could be achieved with fiber Bragg gratings. Therefore, the Applicants believe that Perry does not teach claim 6. Also, although element (760) of Harter suggests the use of a fiber grating compressor, Harter uses a fiber grating stretcher in conjunction with a matched fiber grating compressor (col. 9, lines 10-13 and 27-29). Harter does not teach or

suggest using a fiber Bragg grating stretcher in conjunction with a fiber Bragg grating compressor/bulk grating compressor combination as in claim 6. Therefore, the Applicants believe that claim 6 is allowable as written. For the same reasons the Applicants believe that claim 25 is allowable as amended.

The Examiner asserts that claims 26-28 recite properties that were notoriously well known to be part of a fiber grating compressor at the time of the present application. The Applicants respectfully dispute this statement. There is no showing that at the time of the present application, it was known to use honey or photonic bandgap fibers in a compressor for a chirped pulse amplification system. The Applicants believe that claims 26-28 are allowable as written.

**Rejection of Claims 10 and 11 under § 103(a) as unpatentable over Harter in view of Zweiback**

The Examiner asserts that Harter discloses a chirped pulse amplification system comprising a seed pulse source producing short optical pulses having an inherent spectral bandwidth, a chirped fiber Bragg grating pulse stretcher (720), an amplifier (730) following the stretcher, and a compressor (760) for recompressing the stretched pulses. The Examiner acknowledges that Harter does not teach a fiber Bragg grating pulse stretcher with a group delay ripple of less than 10 ps within the spectral bandwidth of the seed pulse source. However, the Examiner asserts that Figure 3D of Zweiback shows that group delay ripple is a function of how well a fiber Bragg grating is manufactured, and that a group delay ripple of less than 10 ps was obtainable in a fiber Bragg grating at the time of the present application. The Examiner further asserts that it would have been obvious to a person of skill in the art to use the best available

fiber Bragg grating with the Harter invention, and that this grating would have had a group delay ripple of less than 10 ps.

However, Zweiback does not demonstrate that low group delay ripple can be achieved in fiber Bragg gratings for optical bandwidths greater than 1 nm, which are of predominant interest in chirped pulse amplification systems. Although Zweiback demonstrates a group delay ripple on the order of 1 ps in Figure 7, this group delay ripple is only obtained over a bandwidth of at most 1 nm at a wavelength of 1550 nm. In the more general Figures 3A-3E, Zweiback shows a group delay ripple of around 12 ps for a 20 mm stitching error (col. 9, lines 28-29). However, this does not demonstrate that group delay ripple can also be suppressed for bandwidths greater than 1 nm. Because Zweiback does not teach that a low group delay ripple can be obtained over a bandwidth exceeding 1 nm, the Applicants believe that claims 10 and 11 are allowable as amended. The Applicants submit that these comments are also applicable to at least claims 1, 2, 3, 24, 39, and 40.

**Rejection of Claims 15-19 under § 103(a) as unpatentable over Stock in view of Harter**

The Examiner asserts that Stock discloses a device for generating ultra-short pulses comprising a seed pulse source (10) for producing short pulses, a stretcher (20) for stretching the pulses, and a section of predominantly polarization maintaining fiber (30). The Examiner acknowledges that Stock does not disclose that a section of the polarization maintaining fiber is also an amplifier. The Examiner asserts that Harter teaches that it was beneficial for one fiber section to have gain to improve the output, and that it would have been obvious to apply this teaching to the device of Stock to improve the quality of pulses generated.

The Applicants have amended claim 15 to require that at least one polarizer be inserted between any two sections of the polarization maintaining fiber. This is necessary because in highly nonlinear systems subject to self-phase modulation, large spectral modulations are generated (see Figs. 11a and 11b of USP 5,847,863). Neither Stock nor Harter teach or suggest the insertion of a polarizer to reduce the spectral modulation in a chirped pulse amplification system. In fact, Stock limits its device to one section of fiber (30, col. 6, lines 49-51), and does not discuss the use of a polarizer with its device. No prior art reference teaches the insertion of a polarizer between any two sections of polarization maintaining fiber to reduce the spectral modulation. Therefore, the Applicants believe that claim 15 is allowable as amended. Applicants have cancelled claims 16 and 17.

The Applicants have amended claim 18 to emphasize the novelty of polarization maintaining *air-clad* fiber. Although Stock teaches the production of polarization maintaining fibers by incorporating stress-producing regions in the fiber (col. 7, lines 8-11), Stock does not apply this teaching to air-clad fibers. The incorporation of stress-producing regions in the fiber typically leads to large fiber stresses within the fiber body. Because air-claddings are typically very fragile, it was not obvious that air-claddings would be compatible with the production of polarization maintaining fiber. There is no prior art suggesting air-clad polarization maintaining fiber. Therefore, the Applicants believe that claim 18 is allowable as amended. The Applicants have also amended claim 19, which they believe is allowable by dependency.

**Rejection of Claim 48 under § 102(b) as anticipated by Galvanauskas '863**

The Examiner asserts that Galvanauskas '863 discloses a chirped pulse amplification system (Fig. 7) comprising a fiber Bragg grating pulse stretcher system including a plurality of

fiber Bragg gratings (710, 715), each of which is designed to stretch a separate spectral component of an input pulse; at least one optical amplifier following the stretcher; and a pulse compressor for compressing and reconstructing the stretched pulses by incoherent addition.

The Applicants respectfully traverse this rejection. Contrary to the Examiner's assertion, each of the gratings 710 and 715 act on the entire spectral bandwidth of an optical pulse. Grating 715 provides second order phase correction, while grating 710 provides third and fourth order phase correction (col. 12, line 66 - col. 13, line 2). It is well known in the art that higher order phase correction only works when applied to the entire spectrum of the pulse. Also, Galvanauskas '863 does not provide for reconstructing the stretched pulses by incoherent addition of separate spectral components. Therefore, the Applicants believe that claim 48 is allowable as written (with minor typographical corrections).

**Rejection of Claims 49 and 50 under § 103(a) as unpatentable over Harter**

The Applicants believe that claims 49 and 50 are allowable because they depend on claim 48. The Applicants also traverse the Examiner's rejection of these claims. The Examiner asserts that bulk compressor elements were notoriously well known to perform the same function as the compressor (760) disclosed by Harter. However, the function of the compressor system in the present application is to compress and reconstruct stretched pulses by incoherent addition (claim 48). More specifically, the functions of the bulk compressor elements in the present application are to temporally reconstruct the input pulse (claim 49), and to output temporally separated portions of the input pulse (claim 50). In contrast, the compressor (760) in Harter merely compresses the stretched pulses (col. 9, lines 27-29). Harter does not teach or suggest using compressor (760) to reconstruct stretched pulses by incoherent addition, or to perform the

additional functions of the bulk compressor elements discussed above. Therefore, the Applicants believe that claims 49 and 50 are allowable as written (with minor typographical corrections).

**Rejection of Claims 29 and 30 under § 102(b) as anticipated by Galvanauskas '568**

The Examiner asserts that Galvanauskas '568 teaches a chirped pulse amplification system comprising a short pulse seed source (5), a fiber grating pulse stretcher (26), an adaptive pulse shaper (27), at least one amplifier (50), and a pulse compressor (40). The Applicants respectfully traverse this rejection. It is well known in the art that adaptive pulse shaping refers to the ability to adjust the phase and amplitude of an ultrashort pulse, where an arbitrary phase delay greater than $\pi$ and an arbitrary amplitude modulation can be imparted onto the pulse across its entire bandwidth in more than one independently addressable wavelength channel. Contrary to the assertion of the Examiner, element (27) is not an adaptive pulse shaper. Instead, element (27) is a nonlinear compressor that produces shorter pulses by broadening their spectrum (col. 8, lines 42-43). Merely changing the spectral shape of the pulse where all wavelength channels are coupled with each other does not constitute adaptive pulse shaping. Element (27) cannot independently control the phase and amplitude of a number of wavelength channels. Also, element (27) constitutes a nonlinear optical element, whereas adaptive pulse shaping generally refers to the linear manipulation of the phase and amplitude of a pulse. Therefore, element (27) does not function as an adaptive pulse shaper, and the Applicants believe that claim 29 is allowable as written. In addition, because claim 30 depends on claim 29, the Applicants believe that claim 30 is also allowable as written.

**Rejection of Claim 40 under § 102(b) as anticipated by Harter**

The Examiner asserts that Harter teaches a chirped pulse amplification system comprising a *nonlinearly* chirped fiber Bragg grating pulse stretcher (720), at least one fiber amplifier (710) following the stretcher and having a step index profile, and a pulse compressor (760) for compressing the stretched pulses. However, as discussed above, Harter uses only a *linearly* chirped fiber Bragg grating (720) to stretch the pulses (col. 10, lines 16-20). Therefore, the Applicants believe that claim 40 is allowable as amended.

**Objection to Claims 5, 7-9, 31-38, 41, and 45-47**

The Applicants have rewritten dependent claims 5, 7, and 41 in independent form including all of the limitations of the base claim and any intervening claims as new claims 51-53, respectively. Based upon the Examiner's objections, the Applicants believe that these new claims are allowable as written.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

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